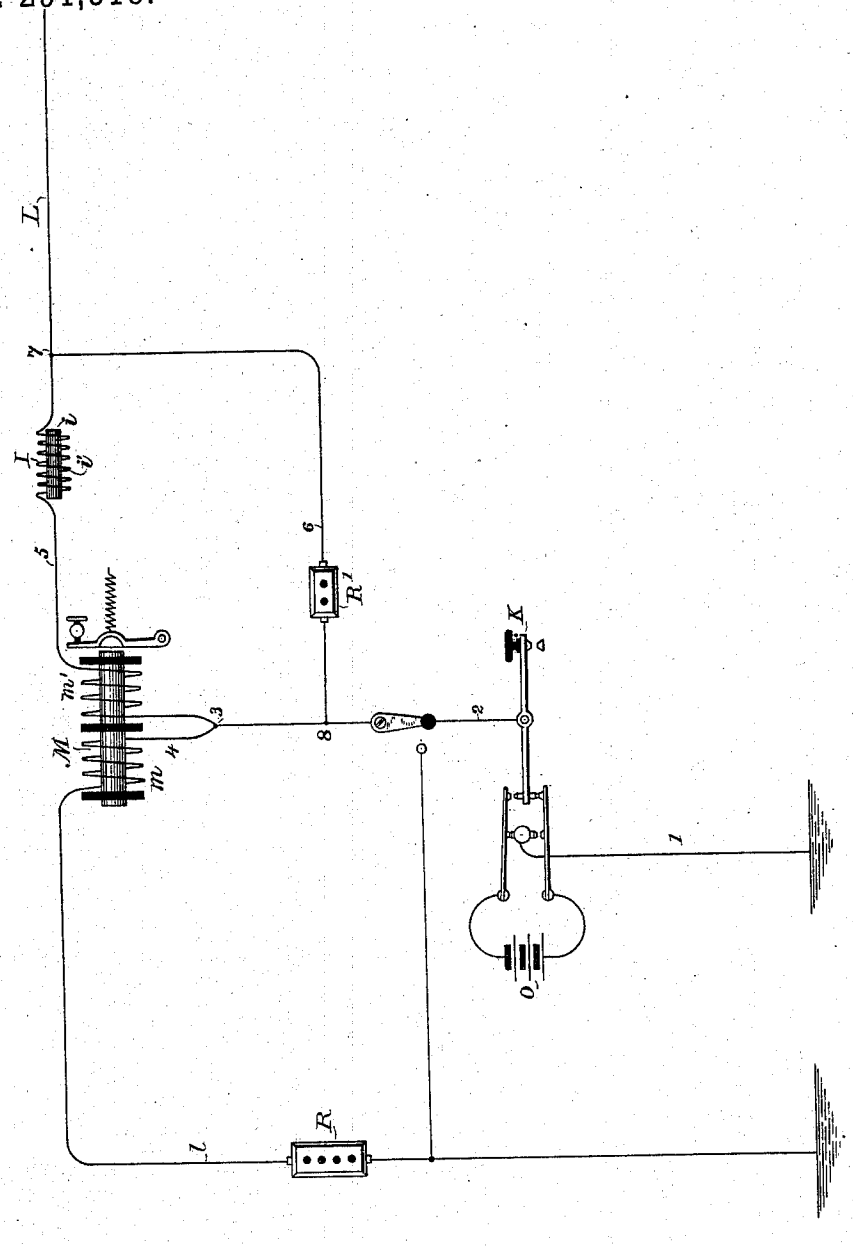
(No Model.)

S. D. FIELD.

DUPLEX TELEGRAPH.

No. 291,318. Patented Jan. 1, 1884.



WITNESSES

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DUPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 291,218, dated January 1, 1884.

Application filed March 30, 1883. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN D. FIELD, a citizen of the United States, and a resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Duplex Telegraphs, of which the following is a specification.

The object of my invention is to apply to an organization of apparatus, such as is commonly employed for duplex telegraphy, means for counteracting the effects produced upon the receiving-instruments at the transmitting-station by the so-called "static discharges" following an interruption of a current established upon the main line, and to obviate the detrimental effects due to the excess of current tending to flow upon the line when first connected with the battery.

To this end my invention consists in combining at the home station, with the necessary transmitting devices and a receiving-instrument adapted to respond only to incoming currents, a branch or shunt circuit, uniting the transmitting device with the main line independently of the receiving-instrument, and containing an adjustable artificial resistance, and in including an electro-magnetic inductor in the portion of the main line thus shunted. The resistances of the two branches, one of which includes the artificial resistance, and the other the receiving-instrument and inductor, are preferably rendered approximately equal, and the inductor is so constructed as both to momentarily oppose the initial flow of current through the conductor connecting the receiving-instrument with the main line, and to acquire a sufficient magnetization under the influence of the outgoing current to establish, upon the interruption of that current, a magneto-electric current of the proper character for counteracting the simultaneous discharge of the main line.

In the accompanying drawing, which is a theoretical diagram illustrating my invention, K represents a pole-changing key adapted to transmit currents of either polarity from a battery, O, upon a conductor, 2, connected with the main line L. A receiving-instrument, M, constructed with a differentially-wound electro-magnet, has one of its coils, *m*, included in the circuit of a conductor, 4, connected at a point, 3, with the conductor 2, and united with an artificial line, *l*. The remaining and oppositely-wound coil or helix *m'* is included in the circuit of a conductor, 5, also connected with the conductor 2, and united at a point, 7, with the main line L. An artificial resistance, R, is included in the line *l*, and so constructed as to offer to the passage of an electric current therethrough a resistance approximately equal to that presented by the main-line circuit. It is well known, however, that the electro-static capacity of a main line is in all cases many times greater than that of an artificial conductor thus constructed, and for this reason it becomes necessary to provide means for counteracting or neutralizing the consequent inequalities in the electrical charge and discharge of the main line, which occur at every variation in the character of the transmitting-current, otherwise momentary uncompensated impulses will be transmitted through the receiving-instrument during the transmission of communications from that station. Another hinderance to rapid transmission is due to the retardation occasioned to the outgoing current by the necessitated flow through the coils of the receiving-instrument during the time its soft-iron core is becoming magnetized.

The aim of my invention is therefore both to provide means for counteracting the effects arising from the difference in the electro-static capacities of the main and artificial lines, and to furnish for the outgoing current a path through which it may reach the main line independently of the conductor, including the receiving-instrument, thus avoiding the retardation to which it would otherwise be subject. For this purpose I provide a branch conductor, 6, leading from a point, 8, in the conductor 2 to a point, 7, in the main line L, and including an adjustable artificial resistance, R'. The conductor 6 constitutes a shunt-circuit around the coil *m'* of the receiving-instrument M in the main line L, and an electro-magnetic inductor, I, included in the conductor 5 between the coil *m'* and the point 7. The inductor I consists of a soft-iron core, *i*, surrounded by a helix, *i'* into which it may be thrust a greater or less distance, as it is desired to increase or lessen its inductive capac-

ity, in a manner well understood. The mass of soft iron comprised in the core *i* is preferably only so much as is required to render the inductor capable of opposing and compensating the static capacity of the main line, and the number of convolutions contained in the surrounding helix *i'* are preferably only sufficient to cause the requisite amount of magnetism to be induced in the core *i* under the influence of an outgoing current of ordinary strength. The artificial resistance R' is so adjusted that the total resistance of the branch or shunt circuit 6 will be approximately equal to the normal resistance of the conductor 5, including the coil *m'* and the inductor I. Owing to the inductive capacity of the last-named circuit, the tendency of the outgoing current is to establish itself upon the main line L through the branch 6 with much greater rapidity than is possible through the conductor 5 until the soft-iron cores have become magnetized, thereby facilitating rapidity of transmission to a corresponding degree. While a current is being established during the act of transmission from the battery O, the inductor I receives a magnetic charge, which, immediately upon the interruption or reversal of the battery current, establishes a current or impulse of the same character as that under the influence of which it was magnetized through the conductors 6 and 3, coil *m'* and conductor 5 to the other terminal of the inductor-coil. This discharge of the inductor I will occur at the same instant as the static discharge from the main line L, before referred to, and by traversing the conductor 5 in a direction opposite thereto will neutralize its effects in the receiving-instrument M. Thus if a current be transmitted from the positive pole of the battery O through the conductor 2 it will divide at the point 8, a portion passing to the line L through the conductor 6 and resistance R'. The remainder of this current will divide at the point 3, a portion passing to the line L by way of the conductor 5, including the coil *m'* of the receiving-instrument M and the inductor I, while the remaining portion of the current will traverse the artificial line *l*, including the coil *m* and resistance R. The portion traversing this last-named circuit will be approximately equal to the sum of the portions which traverse the main line L. At first, however, the portion reaching the main line L through the conductor 5 will be less than that which traverses the conductor 6, a certain amount of force being expended in magnetizing the core *i* of the inductor I. The effect of the inductor is to block the path to the main line through the conductor 5. Immediately after the core *i* has become magnetized, however, the amount of current reaching the line L through the conductor 5 will increase. In this manner, while the line becomes charged at once by means of the current traversing the conductor 6, the tendency of the current to pass to line more rapidly at first than when the line has become charged, is overcome as regards the conductor 5—that is to say, the inductor I prevents a more rapid flow of current through the conductor 5, and thus the coil *m'* during the time the core *i* is being magnetized, and thus during the time the line is receiving its charge, than after the line has become charged. The effect of the outgoing line-currents upon the receiving-instrument M will therefore be practically constant, and, being constant, will be exactly compensated by the currents traversing the coil *m*. When the circuit of the battery O is interrupted or the battery is reversed, the magnetism of the core *i* will be discharged or reversed. Such discharge or reversal will tend to establish in the coil *i'* a current in the same direction as that by means of which it was magnetized. The simultaneous discharge of the line-conductor L, however, is in the direction opposite to that by which it was charged. These currents tending to traverse the coil *m'* in opposite directions neutralize each the effect of the other. When a current is transmitted from the negative pole of the battery O, the operation is precisely similar. In this manner I am enabled both to utilize the inductor for neutralizing the static impulses from the main line and the branch or shunt circuit for increasing the speed of telegraphic transmission.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, with a main and an artificial line, a battery, and means for transmitting impulses therefrom upon said main and artificial line, of a differential electro-magnet having one of its coils included in the circuit of said artificial line and its remaining coil included in the circuit of said main line, an electro-magnetic inductor included in the last-named circuit, and a conductor constituting a permanent shunt-circuit around said inductor and the coil connected with said main line.

2. The combination, substantially as hereinbefore set forth, with a main and an artificial line, a battery, and a transmitting device for simultaneously sending currents or impulses therefrom to said main and artificial lines, of a differential electro-magnet having a corresponding terminal of each of its coils connected with said transmitting device, and the remaining terminals connected, respectively, with said main and artificial lines, an electro-magnetic inductor included in the circuit of said main line, a branch or shunt circuit connecting said transmitting device with said main line independently of said differential electro-magnet and electro-magnetic inductor, and an artificial resistance included in said branch or shunt circuit.

In testimony whereof I have hereunto subscribed my name this 28th day of March, A. D. 1883.

STEPHEN D. FIELD.

Witnesses:
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